

Interim Summary Report

EURL-*Salmonella* Proficiency Test Serotyping 2018

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1. Introduction

This interim summary report describes the overall results on the serotyping part of the Proficiency Test (PT) on typing of *Salmonella* spp. organised by the European Union Reference Laboratory for *Salmonella* (EURL-*Salmonella*, Bilthoven, the Netherlands). Results of the part on PFGE typing will be reported separately.

A total of 36 laboratories participated in this study. These included 29 National Reference Laboratories for *Salmonella* (NRLs-*Salmonella*) in the 28 EU Member States, 3 NRLs of EU-candidate countries, 3 NRLs of EFTA countries, and 1 non-European NRL. The main objective of this study was to check the performance of the NRLs for typing of *Salmonella* spp. and to compare the results of typing of *Salmonella* spp. among the NRLs-*Salmonella*. All NRLs performed serotyping of the strains. Any NRLs of EU Member States that do not achieve the defined level of good performance for serotyping have to participate in a follow-up study, in which 10 additional strains have to be serotyped.

2. Materials and Methods

2.1. *Salmonella* strains for serotyping

A total of 20 *Salmonella* strains (coded S1 - S20) had to be serotyped by the participants. As decided at the 23rd EURL-*Salmonella* Workshop in Uppsala, Sweden, a less common strain (S21) was additionally included in the study. Testing this strain was optional and results were not included in the evaluation.

The *Salmonella* strains used for the study on serotyping originated from the collection of the National *Salmonella* Centre in the Netherlands. The strains were verified by the Centre before distribution. The complete antigenic formulas of the 21 serovars, according to the most recent White-Kauffmann-Le Minor scheme (Grimont and Weill, 2007), are shown in Table 1. However, participants were asked to report only those results, on which the identification of serovar names was based. Three strains (S3, S7, S13) represented serovars included in the EURL-*Salmonella* serotyping studies for the first time.

2.2 Laboratory codes

Each participant was randomly assigned a laboratory code between 1 and 36.

Table 1. Antigenic formulas of the 21 *Salmonella* strains according to the White-Kauffmann-LeMinor scheme used in the 23rd EURL- *Salmonella* typing study

Strain code	O-antigens	H-antigens (phase 1)	H-antigens (phase 2)	Serovar
S1	<u>1</u> ,9,12	g,m	-	Enteritidis
S2	<u>1</u> ,4,12,27	d	1,7	Schwarzengrund
S3 ^{b)}	4,12,27	r	z ₆	Southampton
S4	6,7, <u>14</u>	r	1,5	Infantis
S5	6,8	z ₁₀	e,n,x	Hadar
S6	<u>1</u> ,4,[5],12	i	1,2	Typhimurium
S7 ^{b)}	11	b	1,5	Leeuwarden
S8	6,7, <u>14</u>	r	1,2	Virchow
S9	6,8	e,h	1,5	Kottbus
S10	<u>1</u> ,4,[5],12,[27]	b	e,n,x	Abony
S11	1,3,19	m,t	-	Cannstatt
S12	<u>1</u> ,4,[5],12	f,g	[1,2]	Derby
S13 ^{b)}	<u>1</u> ,9,12	z	1,5	Lawndale
S14	<u>1</u> ,4,[5],12	l,v	e,n,z ₁₅	Brandenburg
S15	<u>1</u> ,4,[5],12	i	1,5	Lagos
S16 ^{a)}	<u>1</u> ,4,[5],12	i	-	4,5:i:-
S17	6,7, <u>14</u>	y	1,5	Bareilly
S18	<u>1</u> ,4,[5],12	e,h	e,n,x	Chester
S19	6,8	r	l,w	Goldcoast
S20	16	c	l,w	Yoruba
S21 ^{c)}	55	k	z ₃₉	55:k:z ₃₉

a) Typhimurium, monophasic variant as determined by PCR.

b) Represented in an EURL-*Salmonella* serotyping study for the first time.

c) *Salmonella enterica* subspecies *salamae* (optional strain).

2.3 Transport

The parcels containing the strains for typing were sent by the EURL-*Salmonella* on 5 November 2018. All samples were packed and transported as Biological Substance Category B (UN 3373) and transported by a door-to-door courier service.

2.4 Evaluation of the serotyping results

The evaluation of the serotyping results as mentioned in this report is described in Table 2.

Table 2. Evaluation of serotyping results

Results	Evaluation
Auto-agglutination or, Incomplete set of antisera (outside range of antisera)	Not typable
Partly typable due to incomplete set of antisera or, Part of the formula (for the name of the serovar) or , No name serovar	Partly correct
Wrong serovar or, Mixed sera formula	Incorrect

In 2007, criteria for 'good performance' in an interlaboratory comparison study on serotyping were defined (Mooijman, 2007). Penalty points are given for incorrect typing of strains, but a distinction is made between the five most important human health-related *Salmonella* serovars (as indicated in EU legislation, also sometimes referred to as 'top-5'), and all other strains:

- 4 penalty points: Incorrect typing of *S. Enteritidis*, *S. Typhimurium* (including the monophasic variant), *S. Hadar*, *S. Infantis* or *S. Virchow*, or assigning the name of one of these 5 serovars to another strain.
- 1 penalty point: Incorrect typing of all other *Salmonella* serovars.

The total number of penalty points is calculated for each NRL-*Salmonella*. The criterion for good performance is set at less than four penalty points. All EU Member State NRLs not meeting the criterion of good performance (four penalty points or more) have to participate in a follow-up study.

3. Results

3.1 Serotyping results of the NRLs-*Salmonella*

3.1.1. General comments on this year's evaluation

As decided at the 23rd EURL-*Salmonella* Workshop, Strain S21 was an additional strain to the study. Testing of this strain was optional and results were not included in the evaluation. One laboratory (Labcode 21) participated for the first time in an EURL-*Salmonella* serotyping study. Because this laboratory only had a limited set of antisera, it was not appropriate to evaluate their results according to the standard procedure as given in 2.4. The results were not taken into account in the overall results of the PT serotyping 2018.

3.1.2. Serotyping results per laboratory

The evaluation of the type of errors for O- and H-antigens and for identification of the strains are shown in Figures 1, 2 and 3. The percentages of correct results per laboratory are shown in Figure 4. The O-antigens were typed correctly by 28 of the 35 participants (80%). This corresponds to 98% of the total number of strains. The H-antigens were typed correctly by 23 of the 35 participants (66%), corresponding to 97% of the total number of strains. As a result, 20 participants (57%) gave the correct serovar names, corresponding to 96% of all strains evaluated.

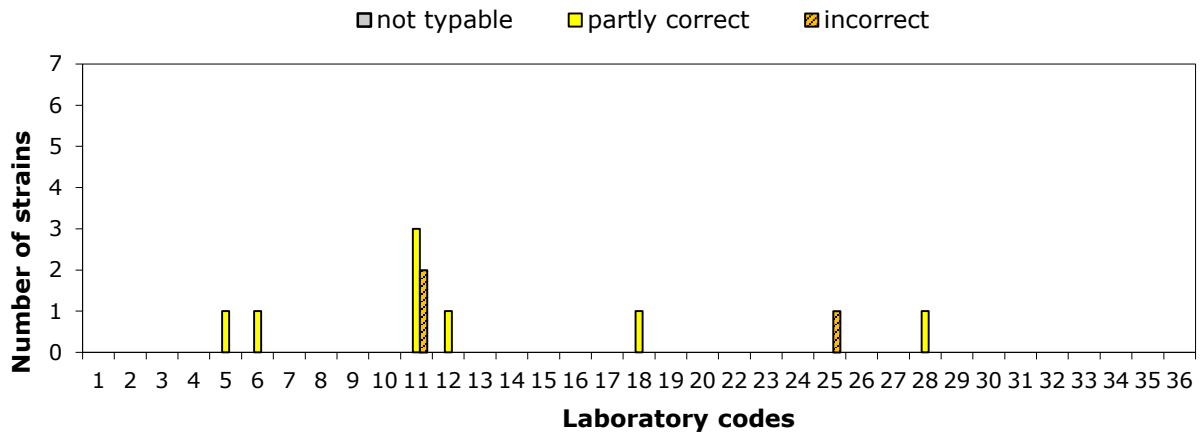


Figure 1. Evaluation of type of errors for O-antigens, per NRL

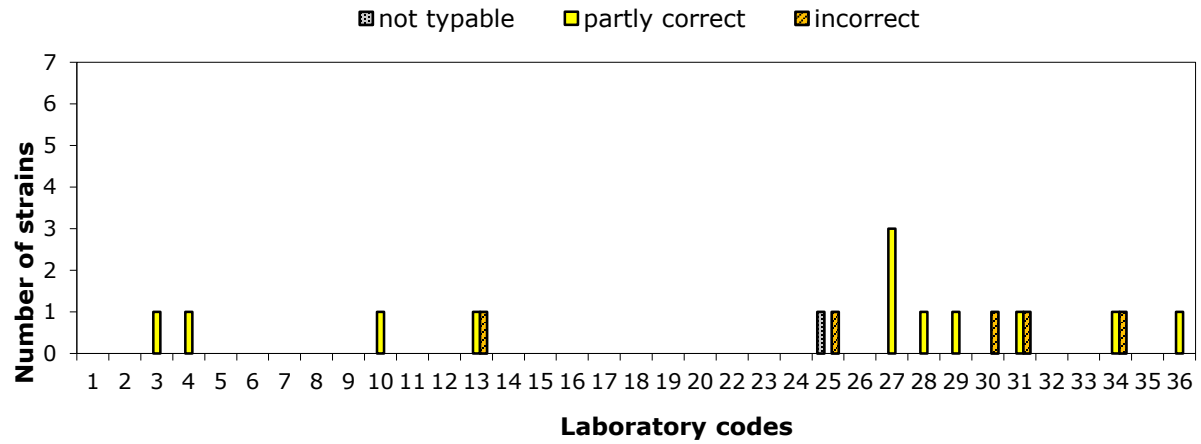


Figure 2. Evaluation of type of errors for H-antigens, per NRL

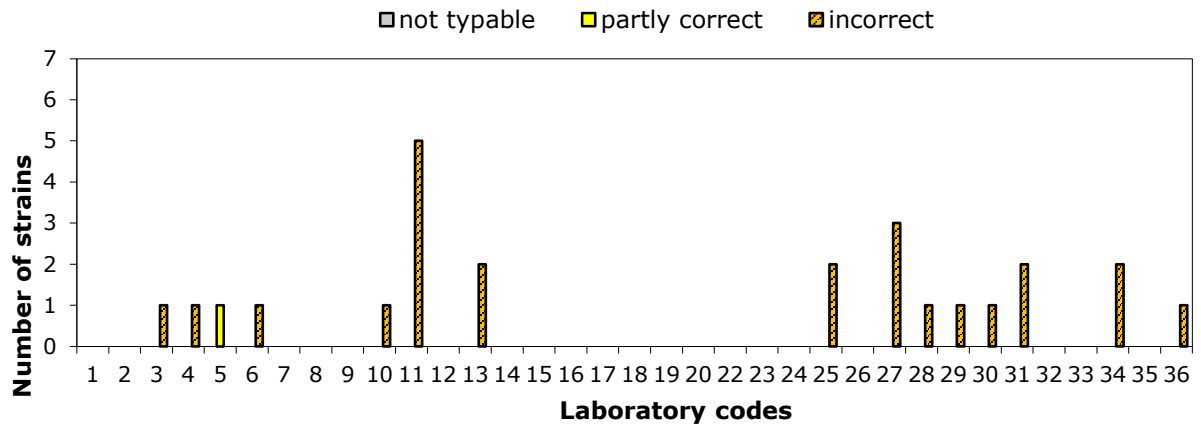


Figure 3. Evaluation of the type of errors in the identification of the serovar names, per NRL

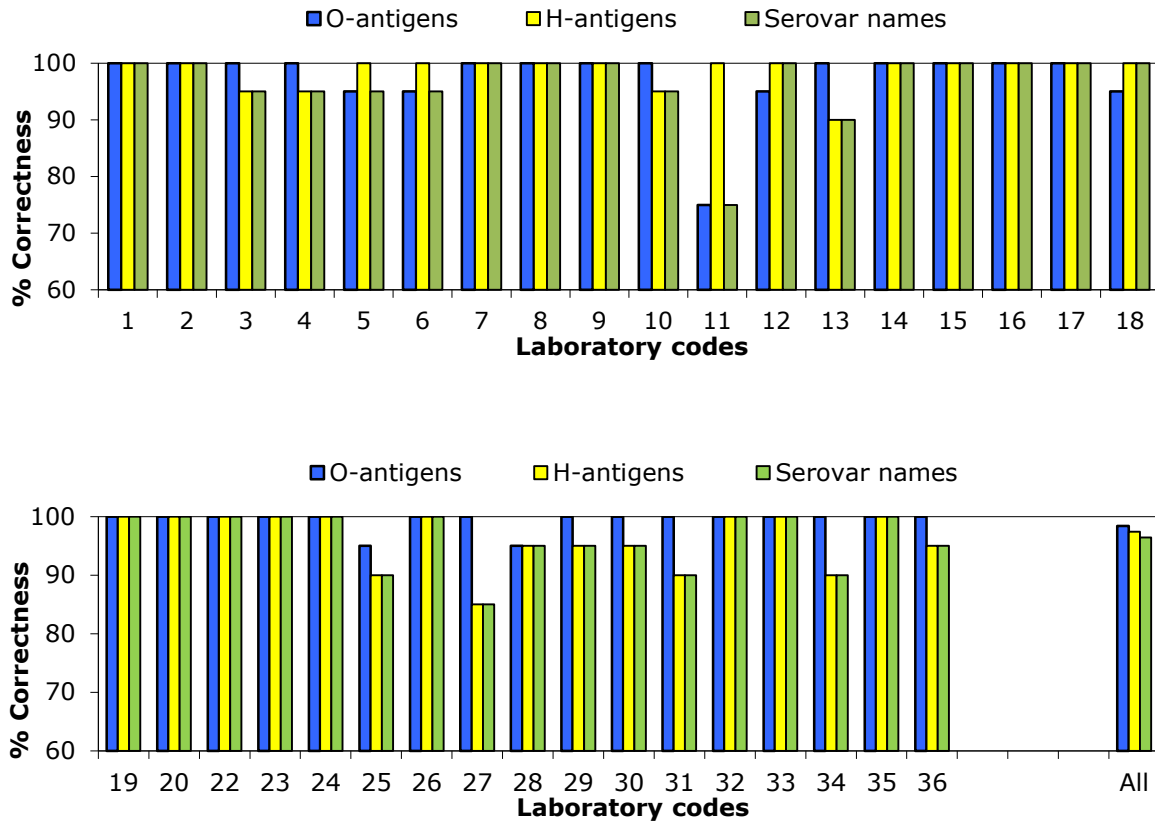


Figure 4. Percentages of correct serotyping results, per NRL

For each NRL the number of penalty points was determined using the guidelines in section 2.4. Table 3 shows the number of penalty points for each NRL, the next column reports whether the level of good performance was achieved or not. Two participants (Lab 11 and Lab 27) did not meet the level of good performance at the first stage of the study and a follow-up study for these laboratories will be organised.

Table 3. Evaluation of serotyping results per NRL

Lab code	Penalty points	Good performance	Lab code	Penalty points	Good performance
1	0	yes	19	0	yes
2	0	yes	20	0	yes
3	1	yes	22	0	yes
4	1	yes	23	0	yes
5	0	yes	24	0	yes
6	1	yes	25	2	yes
7	0	yes	26	0	yes
8	0	yes	27	6	NO
9	0	yes	28	1	yes
10	1	yes	29	1	yes
11	11	NO	30	1	yes
12	0	yes	31	2	yes
13	2	yes	32	0	yes
14	0	yes	33	0	yes
15	0	yes	34	2	yes
16	0	yes	35	0	yes
17	0	yes	36	1	yes
18	0	yes			

3.1.3. Serotyping results per strain

Overall results found per strain and per laboratory are given in Annex A, except for the more complicated strains S16 and S21, which are separately reported in Annex B.

Apart from some spelling errors in the writing, a completely correct identification was obtained for eleven *Salmonella* serovars: Enteritidis (S1), Southampton (S3), Hadar (S5), Typhimurium (S6), Derby (S12), Lawndale (S13), Brandenburg (S14), Lagos (S15), 1,4,[5],12:i:- (S16), Chester (S18), and Goldcoast (S19).

Details on the strains that caused problems in serotyping are shown in Annex C. Strain S11, Cannstatt (1,3,19:m,t:-) clearly gave most problems. Nine laboratories did not name this strain correctly, in six cases this was caused by a mistake in the phase 1 H-antigen determination: reporting g,m,t (Kouka) instead of m,t (Cannstatt).

The reported serovar names for strain 1,4,[5],12:i:- (S16) are shown in Annex B. Seventeen participants used a PCR method to confirm this strain to be a monophasic Typhimurium strain. Details on the additional and optional strain S21 are given in Annex B as well. All but five participants tried to serotype strain S21, a *Salmonella enterica* subsp. *salamae* (II). Only a few laboratories did not have access to the required antisera to finalise this (55:k:z₃₉). Historically, serovar 55:k:z₃₉ was named Tranoroa, but this serovar name is withdrawn now from the WKLM scheme (2007). Serovar names were maintained only for subspecies *enterica* serovars. Serovars of the other subspecies of *S. enterica* and those of *S. bongori* nowadays are designated only by their antigenic formula.

References

Grimont, P.A.D. and Weill, F-X., 2007. Antigenic formulae of the *Salmonella* serovars, 9th ed. WHO Collaborating Centre for Reference and Research on *Salmonella*. Institute Pasteur, Paris, France. https://www.pasteur.fr/sites/default/files/veng_0.pdf (accessed 14/2/2019).

Mooijman K.A., 2007. The twelfth EURL-*Salmonella* workshop; 7 and 8 May 2007, Bilthoven, the Netherlands. National Institute for Public Health and the Environment, Bilthoven, the Netherlands. Report no.: 330604006 (http://www.eurlsalmonella.eu/Publications/Workshop_Reports).

List of abbreviations

EFTA	European Free Trade Association
EU	European Union
EURL- <i>Salmonella</i>	European Union Reference Laboratory for <i>Salmonella</i>
NRLs- <i>Salmonella</i>	National Reference Laboratories for <i>Salmonella</i>
REF	Reference
RIVM	National Institute for Public Health and the Environment

Annex A. Serotyping results per strain and laboratory

Lab:	S1	S2	S3	S4	S5	S6	S7	S8	S9	S10
REF	Enteritidis	Schwarzengrund	Southampton	Infantis	Hadar	Typhimurium	Leeuwarden	Virchow	Kottbus	Abony
1	Enteritidis	Schwarzengrund	Southampton	Infantis	Hadar	Typhimurium	Leeuwarden	Virchow	Kottbus	Abony
2	Enteritidis	Schwarzengrund	Southampton	Infantis	Hadar	Typhimurium	Leeuwarden	Virchow	Kottbus	Abony
3	Enteritidis	Schwarzengrund	Southampton	Infantis	Hadar	Typhimurium	Leeuwarden	Virchow	Kottbus	Abony
4	Enteritidis	Schwarzengrund	Southampton	Infantis	Hadar	Typhimurium	Leeuwarden	Virchow	Kottbus	Abony
5	Enteritidis	Schwarzengrund	Southampton	Infantis	Hadar	Typhimurium	Leeuwarden	Virchow	Kottbus	Abony
6	Enteritidis	Schwarzengrund	Southampton	Infantis	Hadar	Typhimurium	Leeuwarden	Virchow	Kottbus	Abony
7	Enteritidis	Schwarzengrund	Southampton	Infantis	Hadar	Typhimurium	Leeuwarden	Virchow	Kottbus	Abony
8	Enteritidis	Schwarzengrund	Southampton	Infantis	Hadar	Typhimurium	Leeuwarden	Virchow	Kottbus	Abony
9	Enteritidis	Schwarzengrund	Southampton	Infantis	Hadar	Typhimurium	Leeuwarden	Virchow	Kottbus	Abony
10	Enteritidis	Schwarzengrund	Southampton	Infantis	Hadar	Typhimurium	Leeuwarden	Virchow	Newport	Abony
11	Enteritidis	Schwarzengrund	Southampton	Bovismorbificans	Hadar	Typhimurium	Korbol	Bsilla	Ferruch	Abony
12	Enteritidis	Schwarzengrund	Southampton	Infantis	Hadar	Typhimurium	Leewarden	Virchow	Kottbus	Abony
13	Enteritidis	Schwarzengrund	Southampton	Infantis	Hadar	Typhimurium	Leeuwarden	Virchow	Tshiongwe	Abony
14	Enteritidis	Schwarzengrund	Southampton	Infantis	Hadar	Typhimurium	Leeuwarden	Virchow	Kottbus	Abony
15	Enteritidis	Schwarzengrund	Southampton	Infantis	Hadar	Typhimurium	Leeuwarden	Virchow	Kottbus	Abony
16	Enteritidis	Schwarzengrund	Southampton	Infantis	Hadar	Typhimurium	Leeuwarden	Virchow	Kottbus	Abony
17	Enteritidis	Schwarzengrund	Southampton	Infantis	Hadar	Typhimurium	Leeuwarden	Virchow	Kottbus	Abony
18	Enteritidis	Schwarzengrund	Southampton	Infantis	Hadar	Typhimurium	Leeuwarden	Virchow	Kottbus	Abony
19	Enteritidis	Schwarzengrund	Southampton	Infantis	Hadar	Typhimurium	Leeuwarden	Virchow	Kottbus	Abony
20	Enteritidis	Schwarzengrund	Southampton	Infantis	Hadar	Typhimurium	Leeuwarden	Virchow	Kottbus	Abony
21	Enteritidis	*	*	*	Hadar	Auto-agglutination	*	Virchow	*	*
22	Enteritidis	Schwarzengrund	Southampton	Infantis	Hadar	Typhimurium	Leeuwarden	Virchow	Kottbus	Abony
23	Enteritidis	Schwarzengrund	Southampton	Infantis	Hadar	Typhimurium	Leeuwarden	Virchow	Kottbus	Abony
24	Enteritidis	Schwarzengrund	Southampton	Infantis	Hadar	Typhimurium	Leeuwarden	Virchow	Kottbus	Abony
25	Enteritidis	Schwarzengrund	Southampton	Infantis	Hadar	Typhimurium	Nagoya	Virchow	Kottbus	4,12:b:e,n,x
26	Enteritidis	Schwarzengrund	Southampton	Infantis	Hadar	Typhimurium	Leeuwarden	Virchow	Kottbus	Abony
27	Enteritidis	Stanley	Southampton	Infantis	Hadar	Typhimurium	Leeuwarden	Nigeria	Kottbus	Abony
28	S. Enteritidis	S. Schwarzengrund	S. Southampton	S. Infantis	S. Hadar	S. Typhimurium	S. Leeuwarden	S. Virchow	S. Newport	S. Abony
29	Enteritidis	Schwarzengrund	Southampton	Infantis	Hadar	Typhimurium	Leeuwarden	Virchow	Kottbus	Tripoli
30	Enteritidis	Schwarzengrund	Southampton	Infantis	Hadar	Typhimurium	Leeuwarden	Virchow	Kottbus	Abony
31	Enteritidis	Schwarzengrund	Southampton	Infantis	Hadar	Typhimurium	Leeuwarden	Virchow	Kottbus	Abony
32	Enteritidis	Schwarzengrund	Southampton	Infantis	Hadar	Typhimurium	Leeuwarden	Virchow	Kottbus	Abony
33	Enteritidis	Schwarzengrund	Southampton	Infantis	Hadar	Typhimurium	Leeuwarden	Virchow	Kottbus	Abony
34	Enteritidis	Mons	Southampton	Infantis	Hadar	Typhimurium	Leeuwarden	Virchow	Kottbus	Abony
35	Enteritidis	Schwarzengrund	Southampton	Infantis	Hadar	Typhimurium	Leeuwarden	Virchow	Kottbus	Abony
36	Enteritidis	Schwarzengrund	Southampton	Infantis	Hadar	Typhimurium	Leeuwarden	Virchow	Kottbus	Abony
X	0	2	0	1	0	0	2	2	3	1

* incomplete set of antisera

Strain S9 Colonial form variation may have played a role, and therefore considered as a correct answer, also see Protocol 23rd EURL-*Salmonella* typing study (2018).

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S11	S12	S13	S14	S15	S17	S18	S19	S20	Lab:
Cannstatt	Derby	Lawndale	Brandenburg	Lagos	Bareilly	Chester	Goldcoast	Yoruba	REF
Cannstatt	Derby	Lawndale	Brandenburg	Lagos	Bareilly	Chester	Goldcoast	Yoruba	1
Cannstatt	Derby	Lawndale	Brandenburg	Lagos	Bareilly	Chester	Goldcoast	Yoruba	2
Kouka	Derby	Lawndale	Brandenburg	Lagos	Bareilly	Chester	Goldcoast	Yoruba	3
Kouka	Derby	Lawndale	Brandenburg	Lagos	Bareilly	Chester	Goldcoast	Yoruba	4
Cannstatt	Derby	Lawndale	Brandenburg	Lagos	Bareilly	Chester	6,24:r:l,w	Yoruba	5
Southbank	Derby	Lawndale	Brandenburg	Lagos	Bareilly	Chester	Goldcoast	Yoruba	6
Cannstatt	Derby	Lawndale	Brandenburg	Lagos	Bareilly	Chester	Goldcoast	Yoruba	7
Cannstatt	Derby	Lawndale	Brandenburg	Lagos	Bareilly	Chester	Goldcoast	Yoruba	8
Cannstatt	Derby	Lawndale	Brandenburg	Lagos	Bareilly	Chester	Goldcoast	Yoruba	9
Cannstatt	Derby	Lawndale	Brandenburg	Lagos	Bareilly	Chester	Goldcoast	Yoruba	10
Banana	Derby	Lawndale	Brandenburg	Lagos	Tananarive	Chester	Goldcoast	Yoruba	11
Cannstatt	Derby	Lawndale	Brandenburg	Lagos	Bareilly	Chester	Goldcoast	Yoruba	12
Kouka	Derby	Lawndale	Brandenburg	Lagos	Bareilly	Chester	Goldcoast	Yoruba	13
Cannstatt	Derby	Lawndale	Brandenburg	Lagos	Bareilly	Chester	Goldcoast	Yoruba	14
Cannstatt	Derby	Lawndale	Brandenburg	Lagos	Bareilly	Chester	Goldcoast	Yoruba	15
Cannstatt	Derby	Lawndale	Brandenburg	Lagos	Bareilly	Chester	Goldcoast	Yoruba	16
Cannstatt	Derby	Lawndale	Brandenburg	Lagos	Bareilly	Chester	Goldcoast	Yoruba	17
Cannstatt	Derby	Lawndale	Brandenburg	Lagos	Bareilly	Chester	Goldcoast	Yoruba	18
Cannstatt	Derby	Lawndale	Brandenburg	Lagos	Bareilly	Chester	Goldcoast	Yoruba	19
Cannstatt	Derby	Lawndale	Brandenburg	Lagos	Bareilly	Chester	Goldcoast	Yoruba	20
*	*	*	*	Lagos	*	*	*	*	21
Cannstatt	Derby	Lawndale	Brandenburg	Lagos	Bareilly	Chester	Goldcoast	Yoruba	22
Cannstatt	Derby	Lawndale	Brandenburg	Lagos	Bareilly	Chester	Goldcoast	Yoruba	23
Cannstatt	Derby	Lawndale	Brandenburg	Lagos	Bareilly	Chester	Goldcoast	Yoruba	24
3,19:g,m,t:-	Derby	Lawndale	Brandenburg	Lagos	Lomita	Chester	Goldcoast	Yoruba	25
Cannstatt	Derby	Lawndale	Brandenburg	Lagos	Bareilly	Chester	Goldcoast	Yoruba	26
Seftenberg	Derby	Lawndale	Brandenburg	Lagos	Bareilly	Chester	Goldcoast	Yoruba	27
S. Cannstatt	S. Derby	S. Lawndale	S. Brandenburg	S. Lagos	S. Bareilly	S. Chester	S. Goldcoast	S. Yoruba	28
Cannstatt	Derby	Lawndale	Brandenburg	Lagos	Bareilly	Chester	Goldcoast	Yoruba	29
Cannstatt	Derby	Lawndale	Brandenburg	Lagos	Bareilly	Chester	Goldcoast	Lingwala	30
Kouka	Derby	Lawndale	Brandenburg	Lagos	Bareilly	Chester	Goldcoast	Shamba	31
Cannstatt	Derby	Lawndale	Brandenburg	Lagos	Bareilly	Chester	Goldcoast	Yoruba	32
Cannstatt	Derby	Lawndale	Brandenburg	Lagos	Bareilly	Chester	Goldcoast	Yoruba	33
Kouka	Derby	Lawndale	Brandenburg	Lagos	Bareilly	Chester	Goldcoast	Yoruba	34
Canstatt	Derby	Lawndale	Brandenburg	Lagos	Bareilly	Chester	Goldcoast	Yoruba	35
Kouka	Derby	Lawndale	Brandenburg	Lagos	Bareilly	Chester	Goldcoast	Yoruba	36
9	0	0	0	0	2	0	0	2	X

- remark (e.g. spelling error)
- not typable (e.g. antisera not available, rough strain)
- partly correct; in the naming: no penalty points
- incorrect; in the naming: 1 penalty point
- incorrect; in the naming: 4 penalty points

X = number of deviating laboratories (by penalty points) per strain

Results for Strains S16 and S21 are given in Annex B

Annex B. Details on serotyping results strains S16 and S21

Strain code	O-antigens	H-antigens (phase 1)	H-antigens (phase 2)	Serovar	PCR-confirmed	Lab code
S-16	1,4,[5],12	i	-	1,4,[5],12:i:-	Yes	REF
S-16	4,5,12	i	-	4,5,12:i:-	Yes	1
S-16	4	i	-	Typhimurium monophasic variant	Yes	2
S-16	4,5,12	i	-	4,5,12:i:-	No	3
S-16	1,4,5,12	i	-	4,12 : i : -	Yes	4
S-16	4,5,12	i	-	4,5,12:i:-	No	5
S-16	1,4,5,12	i	-	1,4,5,12:i:-	Yes	6
S-16	4,5,12	i	-	4,5,12:i:-	No	7
S-16	4,5,12	i	-	4,5,12:i:-	No	8
S-16	1,4,5,12	i	-	1,4,5,12:i:-	Yes	9
S-16	4,5,12	i	-	Monophasic Typhimurium	Yes	10
S-16	4,5,12	i	-	4,5,12:i:-	No	11
S-16	4	i	-	4:i:-	No	12
S-16	4,5,12	i	-	4,5,12; i; -	No	13
S-16	4,5	i	-	4,5:i:-	Yes	14
S-16	4	i	-	4,5,12:i:-	No	15
S-16	4,5,12	i	-	4,5,12:i:-	Yes	16
S-16	1,4,5,12	i	-	1,4,5,12:i:-	No	17
S-16	1,4,5	i	-	1,4,5;i;- (monophasic ST)	Yes	18
S-16	4,5	i	-	4,5,12:i:-	No	19
S-16	4,5,12	i	-	4,5,12:i:-	No	20
S-16	4,5,12	i	-	4,5,12:i:-	No	21
S-16	4,5,12	i	-	4,5,12:i:-	No	22
S-16	4,5,12	i	-	4,5,12:i:-	Yes	23
S-16	4,5,12	i	-	Typhimurium, monophasic 4,5,12 : i : -	Yes	24
S-16	4,12	i	-	4,12:i:-	No	25
S-16	4,12	i	-	4,5,12:i:-	Yes	26
S-16	4,5,12	i	-	Monophasic Salmonella Typhimurium	No	27
S-16	4,5	i	-	4,5:i:-	No	28
S-16	4,5,12	i	-	4,5,12:i:-	No	29
S-16	4, 5, 12	i	-	4, 5, 12:i:-	No	30
S-16	4,5,12	i	-	4,5,12:i:-	Yes	31
S-16	4,5,12	i	-	4,5,12:i:-	Yes	32
S-16	4,5,12	i	-	4,5,12:i:-	Yes	33
S-16	4,5,12	i	-	4,5,12:i:-	Yes	34
S-16	4,5,12	i	-	4,5,12:i:- Monofasisk Salmonella Typhimurium	Yes	35
S-16	4,5,12	i	-	1,4,5,12:i:-	No	36

Strain code	O-antigens	H-antigens (phase 1)	H-antigens (phase 2)	Serovar	Lab code
S-21	55	k	z39	55:k:z39	REF
S-21	55	k	z39	55:k;z39	1
S-21					2
S-21	55	k	z39	55:k:z39	3
S-21	OMF	k	z39	OMF : k : z39 (II)	4
S-21	55	k	z39	55:k:z39	5
S-21	55	k	z39	S.II 55:k:z39	6
S-21	55	k	z39	SG II 55:k:z39	7
S-21	55	k	z39	55:k:z39	8
S-21	55	k	z39	55:k:z39	9
S-21	55	k	z39	SubspII: 55:k:z39	10
S-21	55	k	z39	II 55:k:z39	11
S-21	55	k	z39	II 55:k:z39	12
S-21	55	k	z39	55; k; z39	13
S-21	55	k	z39	55:k:z39	14
S-21	55	z39	k	55:z39,k	15
S-21	55	k	z39	55:k:z39 (II)	16
S-21	55	k	z39	55:k:z39	17
S-21	55	k	z39	55;k;z39	18
S-21	55	k	z39	S. II (Salmonella enterica subsp. salamae) 55:k:z39	19
S-21	55	k	z39	55:k:z39	20
S-21	-	-	-	Incomplete set of antisera	21
S-21					22
S-21	OMF	k		III a arizonae	23
S-21	55	k	z39	Salmonella enterica subsp. salamae serovar 55 : k : z39	24
S-21	-	k	-	-:k: -	25
S-21	55	k	z39	II 55:k:z39	26
S-21	55	k	z39	II	27
S-21	55	k	z39	55:k:z39	28
S-21	55	k	z39	S.enterica subsp. salamae 55:k:z39	29
S-21					30
S-21	55	k	z39	55:k:z39	31
S-21		k			32
S-21	55	k	z39	Tranoroa	33
S-21	-	k	Z35	-:k:z35	34
S-21	55	k	z39	55:k:z39	35
S-21					36

Annex C. Details per strain that caused problems in serotyping

Strain code	O-antigens	H-antigens (phase 1)	H-antigens (phase 2)	Serovar	Lab code
S-2	<u>1,4,12,27</u>	d	1,7	Schwarzengrund	REF
S-2	4,12	d	1,7	Schwarzengrund	20
S-2	4,12	d	1,2	Stanley	27
S-2	4,12,27	d	l,w	Mons	34
S-3	<u>4,12,27</u>	r	z6	Southampton	REF
S-3	1,4	r	z6	Southampton	18
S-4	<u>6,7,14</u>	r	1,5	Infantis	REF
S-4	6,8	r	1,5	Bovismorbificans	11
S-7	11	b	1,5	Leeuwarden	REF
S-7	8	b	1,5	Korbol	11
S-7	11	b	1,5	Leewarden	12
S-7	6,8	b	1,5	Nagoya	25
S-8	<u>6,7,14</u>	r	1,2	Virchow	REF
S-8	6,8	r	1,2	Bsilla	11
S-8	8,6,7	r	1,2	Virchow	12
S-8	6,7	r	1,6	Nigeria	27
S-8	6,7	r	2	Wirchow	32
S-9	6,8	e,h	1,5	Kottbus	REF
S-9	6,8	e,h	1,2	Newport	10
S-9	6,8	e,h	e,n,z15	Tshiongwe	13
S-9	6,8,20	e,h	1,2	S. Newport	28
S-10	<u>1,4,[5],12,27</u>	b	e,n,x	Abony	REF
S-10	4	b	x,z16	Abony	19
S-10	4,12	b	e,n,x	4,12:b:e,n,x	25
S-10	4,12	b	z6	Tripoli	29
S-10	4,5,12	b	e,x	Abony	34
S-11	<u>1,3,19</u>	m,t	-	Cannstatt	REF
S-11	19	g,m,t	-	Kouka	3
S-11	1,3,19	g,m,t	-	Kouka	4
S-11	3,10	m,t	-	Southbank	6
S-11	4,12	m,t	-	Banana	11
S-11	1,3,19	g,m,t	-	Kouka	13
S-11	3,19	g,m,t	-	3,19:g,m,t:-	25
S-11	3,19	g,t	-	Seftenberg	27
S-11	1,3,19	g,m,t	-	Kouka	31
S-11	3,19	g,m,t	-	Kouka	34
S-11	1,3,19	g,m,t	-	Kouka	36
S-14	<u>1,4,[5],12</u>	l,v	e,n,z15	Brandenburg	REF
S-14	4	l,w	e,n,z15	Brandenburg	18
S-17	<u>6,7,14</u>	y	1,5	Bareilly	REF
S-17	6,8	y	1,5	Tananarive	11
S-17	6,7	e,h	1,5	Lomita	25
S-19	6,8	r	l,w	Goldcoast	REF
S-19	6,24	r	l,w	6,24:r:l,w	5
S-19	6,8	r	l,v	Goldcoast	27
S-20	16	c	l,w	Yoruba	REF
S-20	16	z	1, 7	Lingwala	30
S-20	16	c	e,n,x	Shamba	31